OBJECTIVES
The aim of this study was to evaluate the antimicrobial effect of a locally delivered 14% doxycycline gel applied on machined and rough implant surfaces in an experimental peri-implantitis model.

MATERIALS AND METHODS
Twenty-four smooth and twenty-four rough sterile 4.2x10mm implants (i-Fix Uniqo, FMD Medical Device, Rome, Italy) were placed into screwcaps glasses that were then filled with 3% cc of sterile agar in order to leave the last 2mm of the apical portion of the implant exposed. The samples were divided into 4, equally divided, groups according to surface and treatment modality: rough test, rough negative control, smooth test, smooth negative control.

After agar gelification, the exposed portion of the implant was inoculated with 10 microliters of S sanguinis transported in tryptic soy broth. The glasses were then placed in an incubator with the atmosphere of 5% CO2 at 37 Celsius degrees for 24 hours to allow the bacteria to grow. After 24 hours, the test groups were treated with the doxycycline (Ligossan, Heraeus Kulzer, Hanau, Germany) injecting the gel circumferentially over the exposed surface of the implant for 3 minutes. The gel was then mechanically washed with a sterile excavator and all the implants were took off from the screwcap glasses and placed in microtubes containing 600 cc of tryptic soy broth and vortexed to allow the bacteria to detach from the surface. The samples were then diluted 1:100 and plated on tryptic soy agar plates. The plates were placed in an incubator with the atmosphere of 5% CO2 at 37 Celsius degrees for 48 hours. After incubation, the colony forming units were eye-counted and recorded. The statistical analysis was done through independent samples T-test.

RESULTS
Our study shows that the use of a 14% doxycycline gel, without considering the differences of surfaces, minimize CFU counts compared to the control groups, with the difference being statistically significant. However, when comparing the surfaces groups separately, although the reduction of CFUs is visibly evident between the rough groups, the difference doesn’t reach statistically significance. The reduction of CFUs between the smooth groups (control and test) is more marked than in the rough groups, with the difference being statistically significant (p <0.05).

DISCUSSION
Local antibiotics have been showed to be successful in peri-implant decontamination and, in particular, doxycycline has shown to be effective in improving clinical parameters. Anyway, to date no scientific data have validated the effectiveness of 14% locally delivered doxycycline gel in the decontamination of implant surfaces being them machined or rough.

In this study the use of 14% doxycycline gel has shown to be effective on both smooth and rough implant surfaces with a more pronounced reduction on the smooth implants. As expected the machined surfaces are more prone to be decontaminated probably because the smoothness of the surface doesn’t prevent the decontaminating agent to penetrate in the most deep and hided irregularities of the titanium surface. The CFUs reduction doesn’t reach statistical significance in the rough groups probably because of the limited number of samples in this study. Anyway, a trend of reduction in the bacterial colonies is evident in both test groups.

CONCLUSIONS
The use of 14% doxycycline gel in implant surface decontamination was efficacious in this in-vitro study regardless the implant surface. Adjunctive use of locally delivered 14% doxycycline gel is a viable option in the management of peri-implantitis and peri-implant mucositis considering its efficacy in reducing bacterial colonization. Further studies with larger samples size should be carried out to validate and strengthen our conclusions.

REFERENCES

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Giuseppe Pio Patianna, Nicola Alberto Valente, Antonio D'Addona, Sebastiano Andreana

Evaluation of local 14% doxycycline gel for bacterial decontamination on rough and smooth implant surfaces

Poster: Clinical report

Aim: The aim of this study was to evaluate the antimicrobial effect of a locally delivered 14% doxycycline gel (Ligossan, Heraeus Kulzer, Hanau, Germany), applied on machined and rough implant surfaces in an experimental peri-implantitis model.

Materials and methods: Twenty-four smooth and twenty-four rough sterile 4.8 x 10.0 mm implants (i-Fix UniQo, FMD Medical Device, Rome, Italy) were placed into screwcap glasses that were then filled with 3.5 cc of sterile agar, in order to leave the last 2 mm of the apical portion of the implant exposed. The samples were divided into four equally divided groups according to surface and treatment modality: rough test, rough negative control, smooth test and smooth negative control. After agar gelification, the exposed portion of the implant was inoculated with 10 µl of S. sanguinis transported in tryptic soy broth. The glasses were then placed in an incubator with an atmosphere of 5% CO₂ at 37°C for 24 h to allow the bacteria to grow. After 24 h, the test groups were treated with the doxycycline, injecting the gel circumferentially over the exposed surface of the implant for 3 min. The gel was then mechanically removed with a sterile excavator and all the implants were taken off from the screwcap glasses and placed in microtubes containing 600 cc of tryptic soy broth, and vortexed to allow the bacteria to detach from the surface. The samples were then diluted 1:100 and plated on tryptic soy agar plates. The plates were placed in an incubator with an atmosphere of 5% CO₂ at 37°C for 48 h. After incubation, the colony forming units were eye-counted and recorded. The statistical analysis was done through the Kruskal-Wallis test.

Results: Our study shows that the use of 14% doxycycline gel minimise CFU counts compared to the control groups, with the difference being statistically significant. Only a modest increase in the decontamination effect was obtained on the smooth surfaces, however, there was no statistically significant difference compared to the rough test group.

Local antibiotics have been shown to be successful in peri-implant decontamination and, in particular, doxycycline has shown to be effective in improving clinical parameters. To date, no scientific data has validated the effectiveness of 14% locally delivered doxycycline gel in the decontamination of implant surfaces, whether they are machined or rough.

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Conclusions: The use of 14% doxycycline gel in implant surface decontamination was efficacious in this in vitro study, regardless of the implant surface. Adjunctive use of locally delivered 14% doxycycline gel is a viable option in the management of peri-implantitis and peri-implant mucositis, considering that it reduces bacterial colonisation.
Evaluation of local 14% doxycycline gel for bacterial decontamination on rough and smooth implant surfaces

G. Patianna, N. Valente, A. D’Addona, S. Andreana
1Università Cattolica del Sacro Cuore di Roma, Ceglie messapica, Italy, 2 State University of New York at Buffalo, Buffalo, USA, 3Università Cattolica del Sacro Cuore, Rome, Italy

Background: There is no reliable evidence suggesting which could be the most effective interventions for treating peri-implantitis. Nonsurgical treatment has been shown to be effective in dealing with inflammatory lesions around implant without bone loss. However, when bone loss is noticed, surgical treatment may be needed. Nonetheless, before the surgical approaches can be effective, the contaminated implant surface has to been detoxified. Since peri-implantitis lesions are usually well demarcated, controlled delivery devices, originally developed for the therapy of localized periodontal infections, may be a successful means of treatment for peri-implantitis. Local antibiotics have been showed to be successful in peri-implant decontamination and, in particular, doxycycline has shown to be effective in improving clinical parameters. Anyway, to date no scientific data have validated the effectiveness of 14% locally delivered doxycycline gel in the decontamination of implant surfaces being them machined or rough.

Aim/Hypothesis: The aim of this study was to evaluate the antimicrobial effect of a locally delivered 14% doxycycline gel (Ligosan, Heraeus Kulzer, Hanau, Germany) applied on machined and rough implant surfaces in an experimental peri-implantitis model.

Material and Methods: Twenty-four smooth and twenty-four rough sterile 4.2x10 mm implants (i-Fix Uniqo, FMD Medical Devices, Rome, Italy) were placed into screwcap glasses that were then filled with 3½ cc of sterile agar in order to leave the last 2 mm of the apical portion of the implant exposed. The samples were divided into 4, equally divided, groups according to surface and treatment modality: rough test, rough negative control, smooth test, smooth negative control. After agar gelification, the exposed portion of the implant was inoculated with 10 microliters of S sanguinis transported in tryptic soy broth. The glasses were then placed in an incubator with the atmosphere of 5% CO2 at 37 Celsius degrees for 24 hours to allow the bacteria to grow. After 24 hours, the test groups were treated with the doxycycline (Ligosan, Heraeus Kulzer, Hanau, Germany) injecting the gel circumferentially over the exposed surface of the implant for 3 minutes. The gel was then mechanically removed with a sterile excavator and all the implants were took off from the screwcap glasses and placed in microtubes containing 600 cc of tryptic soy broth and vortexed to allow the bacteria to detach from the surface. The samples were then diluted 1:100 and plated on tryptic soy agar plates. The plates were placed in an incubator with the atmosphere of 5% CO2 at 37 Celsius degrees for 48 hours. After incubation, the colony forming units were eye-counted and recorded. The statistical analysis was done through independent samples T-test.

Results: Our study shows that the use of a 14% doxycycline gel, without considering the differences of surfaces, minimize CFU counts compared to the control groups, with the difference being statistically significant. However, when comparing the surfaces groups separately, although the reduction of CFUs is visibly evident between the rough groups, the difference doesn’t reach statistically significance. The reduction of CFUs between the smooth groups (control and test) is more marked than in the rough groups, with the difference being statistically significant (P < 0.05).

Conclusions and Clinical Implications: The use of 14% doxycycline gel in implant surface decontamination was efficacious in this in-vitro study regardless the implant surface. Adjunctive use of locally delivered 14% doxycycline gel is a viable option in the management of peri-implantitis and peri-implant mucositis considering its efficacy in reducing bacterial colonization. Further studies with larger samples size should be carried out to validate and strengthen our conclusions.
Valutazione di un gel locale di Doxiciclina al 14% nella decontaminazione di superfici implantari rugose e macchinate.

Authors: PATIANNA G.P.1(*), VALENTE N.A.2, D’ADDONA A.1, ANDREANA S.2
Affiliations: 1Università Cattolica del Sacro Cuore, Corso di Laurea Magistrale in Odontoiatria e Protesi Dentaria, Roma, Italia
2 State University of New York at Buffalo, School of Dental Medicine, Buffalo NY, Stati Uniti
Parole chiave: terapia antibiotica locale; doxiciclina; decontaminazione; impianti dentali; peri-implantite.

ABSTRACT:
Obiettivo: L’obiettivo di questo studio è stato quello di valutare l’efficacia antimicrobica di un gel a rilascio controllato di doxiciclina al 14% (Ligosan, Heraeus Kulzer, Hanau, Germany) applicato su superfici implantari rugose e macchinate, in un modello sperimentale di peri-implantite.
Materiali e metodi: Ventiquattro impianti con superficie macchinata e ventiquattro impianti con superficie rugosa (i-Fix Uniqo, FMD Medical Devices, Rome, Italy) sono stati posizionati all’interno di boccette in vetro successivamente riempite con 3½ cc di agar sterile al fine di lasciare esposti gli ultimi due millimetri della porzione apicale degli impianti. I campioni sono stati equamente suddivisi in 4 gruppi a seconda della tipologia di superficie e della modalità di trattamento: gruppo test su impianti rugosi, gruppo controllo negativo con impianti rugosi, gruppo test su impianti macchinati, gruppo controllo negativo con impianti macchinati. Dopo la gelificazione dell’agar, la porzione esposta di ciascun impianto è stata inoculata con 10 microlitri di S. Sanguinis trasportato in brodo di soia trittico. Le boccette in vetro sono state quindi posizionate in incubatore al 5% di CO2 e 37 gradi Celsius per 24 ore per permettere la crescita dei batteri. Dopo 24 ore, i gruppi test sono stati trattati con doxiciclina depositando il gel circonferenzialmente alla superficie esposta degli impianti per 3 minuti. Il gel è stato successivamente rimosso con un escavatore sterile e tutti gli impianti sono stati rimossi dalle boccette in vetro e posizionati all’interno di microtubi contenenti 600 cc di brodo di soia trittico e vortexati per permettere ai batteri di distaccarsi dalla superficie. I campioni sono stati diluiti 1:100 e piastrati su piastre di agar. Le piastre sono state posizionate in incubatrice con l'atmosfera al 5% CO2 a 37 gradi Celsius per 48 ore. Dopo l’incubazione, le unità formanti colonie sono state contate ad occhio e registrate. L’analisi statistica è stata effettuata con l’independent samples T-test.

Risultati
Il nostro studio dimostra che l’utilizzo di un gel al 14% di doxiciclina minimizza le CFU rispetto ai gruppi controllo, con la differenza statisticamente significativa. Tuttavia, comparando i gruppi relativamente alla tipologia di superficie, nonostante la riduzione di CFU sia visibilmente evidente anche nel gruppo di impianti rugosi, la differenza non raggiunge la significatività statistica. La riduzione di CFU fra gli impianti a superficie macchinata (test e gruppo controllo) è molto più marcata rispetto agli impianti a superficie rugosa, con la differenza statisticamente significativa.

Discussione
Gli antibiotici locali si sono dimostrati efficaci nella decontaminazione implantare e, in particolare, la doxiciclina si è dimostrata efficace nel migliorare i parametri clinici. Tuttavia, ad oggi non esistono dati scientifici circa l’efficacia del gel al 14% di doxiciclina a rilascio controllato nella decontaminazione di superfici implantari rugose o macchinate.

In questo studio, il ricorso al gel al 14% di doxiciclina si è dimostrato efficace sia su superfici rugose che su superfici macchinate, con una maggiore e pronunciata riduzione nel gruppo di impianti macchinati. Ciò è dovuto alla maggiore facilità decontaminante delle superfici macchinate probabilmente dovuta al fatto che la lucidità di queste superfici non impedisce all’agente topico decontaminante la penetrazione nelle più profonde e nascoste irregolarità della superficie del titano. La riduzione delle CFU non raggiunge la significatività statistica nel gruppo di impianti rugosi probabilmente a causa del numero limitato di campioni utilizzati in questo studio. Tuttavia, un trend di riduzione della conta batterica è evidente in entrambi i gruppi test.

Conclusione
L’uso del gel a rilascio controllato di doxiciclina al 14% è efficace nella decontaminazione di superfici implantari macchinate e rugose. L’uso aggiuntivo del gel a rilascio controllato di doxiciclina al 14% è un’opzione considerabile nel management della peri-implantite e della peri-mucosite, considerando la sua efficacia nella riduzione della colonizzazione batterica. Ulteriori studi con un numero di campioni maggiore dovrebbero essere condotti per validare e rafforzare le nostre conclusioni.